THE ACTIVITY OF A SOURCE OF ARTICULATION

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ABSTRACT. The article gives the results of an experimental study of the activity of a source of articulation and the possibility of reducing it. To do this, the statistical features of juncture in the Russian language were examined, along with the effect of prolonged, artificial juncture in speech on its discrimination.

The activity of the source of articulation plays an important role when /496* using the statistical mean of the transmitted signals in the communication channels as an ensemble.

By the activity of the source, as is known [1], we mean the apriori assumption of the fact that the source, which is considered active, actually produces information. This article will give the results of an experimental study of the activity of the source of articulation and the possibility of reducing it.

In order to do this, we investigated the statistical features of the plus juncture in the Russian language, and the effect of prolonged, artificial juncture in speech on its discrimination.

Our investigation of the statistical features of the plus juncture in the Russian language was done using a specially designed device, the schematic diagram of which is shown in Figure 1.

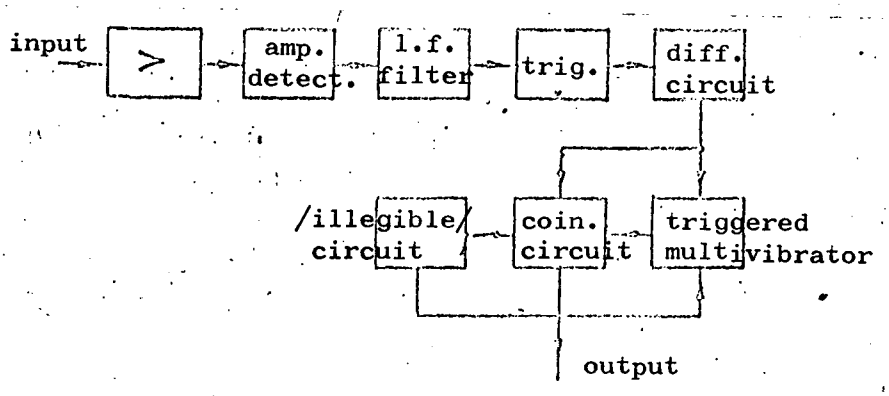

Figure 1. Schematic diagram of the juncture analyzer

* Numbers in the margins indicate pagination in the foreign text.

The basis for the device was the transformation of plus juncture into impulses and the standardization of these impulses with respect to wavelength.

The investigations yielded a histogram of the distribution of the length of the plus juncture and a histogram of the distribution of the length of the intervals between them. On the basis of the results of the experiment, we calculated: the average length of the juncture, 84 μsec, the distribution of the length of the juncture, 91 μsec^2, and the maximum length of the juncture, 800 μsec, as well as the minimum length of the juncture, 20 μsec. The analogous parameters for the length of the intervals between the junctures had the magnitudes: 520 μsec, 1,370 μsec^2, 3,000 μsec and 40 μsec. We also computed the third and fourth moment of the distribution, as well as values for the asymmetry and /illegible/ using the concept of standardization of the probability-density function, we obtained the analytical expressions for the probability-density function of the length of the juncture and for the probability-density function of the interval between the junctures, which approach the experimentally obtained distributions: /497

$$W(\tau) = \frac{1.56}{\sqrt{2\pi}} \frac{1}{\sqrt{\tau^2+1}} \exp\left[-\frac{1}{2}(7.35 - 1.56 \operatorname{arsh} \tau)^2\right]$$

$$W(T) = \frac{4.1}{\sqrt{2\pi}} \frac{1}{\sqrt{T^2+1}} \exp\left[-\frac{1}{2}(5.9 - 1.1 \operatorname{arsh} T)^2\right]$$

where T, τ are expressed in μsec.

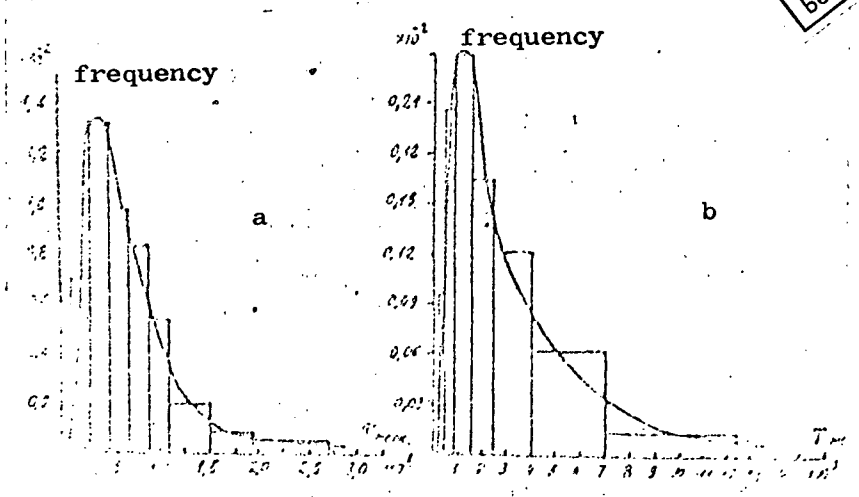

Figure 2. a - Distribution of the length of the juncture; b - Distribution of the length of the intervals between the junctures

The overall amount of time taken up by the junctures in speech amounts to 14%, i.e. articulatory activity is 0.84. /498

The activity of the source of articulation can also be reduced by using artificial junctures in the articulatory signal. Similar investigations have already been carried out by a series of authors, however they investigated brief interruptions of $\ll 1$ μsec, [2, 3] which were difficult to use to transmit other information, as is done in systems using statistical means.

Figure 3 gives the results of the experimental investigation of the dependence of auditory discrimination of speech on the magnitude of the intervals between the junctures, when the length of the junctures was 5, 10, and 20 μsec. We also investigated the effect of accidental interruptions, and the results are given by curve 1 in Figure 3.

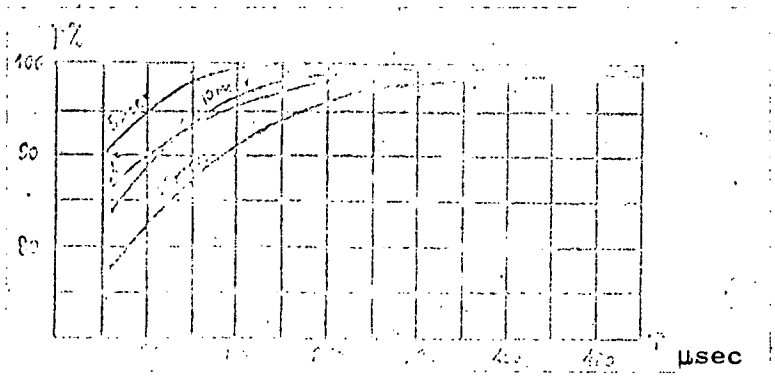

Figure 3. Auditory discrimination of interrupted Russian speech

As can be seen from the graphs, junctures with a length of from 5 to 20 μsec, the latter with a frequency of less than 5 Hz, have little effect on discrimination, and articulatory activity can be reduced to 0.7 by means of prolonged interruptions. /499

The results obtained on the statistics of the plus juncture and the effect of interruptions showed that the activity of the source of articulation is sufficiently large and it can be used only to transmit small flows of information in systems with statistical means.

REFERENCES

[1] Svenson, A.N., Smerdov, A.A. Sistemy peredachi informatsii so staticheskim usredneniyem [Systems for Transmitting Information Using Statistical Means], Kiev, 1967, Naukova dumka Publishing House.

[2] Gordiyenko, A.G. "Discrimination of Plus Juncture in Russian", Nauchno-tekhnicheskiy sbornik, Vol. 1, No. 26, 1958, Moscow.

[3] Medvedev, Yu.I. Ekstrapolyatsionnyye metody bor'by s impul'snymi pomekhami pri radiopriyeme [Methods of Extrapolating Impulse Noise Abatement in Radio Reception], Doctoral Dissertation, Gor'kiy, 1966.

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